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Soil Modeling and Soil Moisture Changes Depending on the Level of Groundwater

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Abstract: This article provides information on the creation of a mathematical model by analyzing data on changes in the soil layer and soil moisture depending on changes in the level of seeping water.

Keywords: groundwater level, mathematical model, elements, soil, soil moisture, soil saturation, equation, aeration, formula.

Introduction

In arid regions of the world, the method of irrigating crops occupies one of the leading places. "Considering, in the world, that 75% of the irrigated areas, with an area of more than 280.0 million hectares, are irrigated by this method, it is important to introduce improved reclamation techniques for managing soil moisture in this way.

In the world, research work is underway aimed at studying the hydraulic parameters of the water flow and the infiltration properties of the soil. In this regard, modeling of moisture migration in interconnected flows of surface and ground waters, models of mass transfer in the interconnected movement of surface and seepage waters that take into account the process of mass transfer between various constituent water flows, and scientific research on the management of changes in soil moisture zone have been given special attention to technical issues. .

In our republic, extensive measures are being taken to develop resource-saving methods and technologies that allow saving water resources when irrigating crops, and certain results are being achieved in this regard. The Action Strategy for five priority areas of development of the Republic of Uzbekistan in 2017-2021 defines important tasks, including "... first of all, the introduction of modern agricultural technologies that save water resources, the use of agricultural machinery with high productivity." In carrying out these tasks, among other things, it is important study of patterns of interdependence of the dynamics of irrigation water consumption, intensity saturation and depth of water infiltration, development models of changes in soil and soil moisture depending on the change in the level of seeping water.

Main part

Based on the foregoing, when developing a mathematical model, we use the equilibrium equation for an elementary volume of water up to a conditional lower limit or limiting water with a height L from ground level, taking into account the separation of water W1 to the shared

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volume and W2 from an elementary volume; after θ the increase in soil moisture is expressed [1]:

$$\frac{\partial}{\partial t}\int_0^L \theta dz = W_1 - W_2 \qquad (1)$$

In the water-saturated part of the soil, the rise in the groundwater level is expressed as follows:

$$\mu \frac{\partial h}{\partial t} = W_1 - W_2 \qquad (2)$$

Now consider the moisture reserve separately in the saturated part of the soil and in the aerated part:

$$\frac{\partial}{\partial t}\int_0^L \theta dz = \frac{\partial}{\partial t}\int_0^{L_1} \theta dz + \frac{\partial}{\partial t}\int_{L_1}^L \theta dz \qquad (3)$$

saturation factor $\mu_H = \theta_m - \theta_e$, θ_m - total soil moisture (below the groundwater level), θ_e - soils in dry air (above the free surface). As an experiment, many researchers have found that the coefficient ranges from 0.05-0.25 for sand, loam and sandstone. μ_H

moisture content of the saturated part of the soil θ_m corresponds to the total moisture capacity, it can be considered constant:

$$\frac{\partial}{\partial t}\int_0^L \theta dz = \theta_m \frac{\partial h}{\partial t} + \frac{\partial}{\partial t}\int_{L_1}^L \theta dz \qquad (4)$$

Equation (4) can be adapted to the non-stationary filtering equation (5), i.e.

$$\mu_H \frac{\partial h}{\partial t} = \theta_m \frac{\partial h}{\partial t} + \frac{\partial}{\partial t}\int_{L_1}^L \theta dz$$

as well as $\frac{\partial}{\partial t}\int_{L_1}^L \theta dz = (\mu_H - \theta_m)\frac{\partial h}{\partial t}$ we accept (5)

Equation (5) describes the dynamics of changes in soil moisture depending on changes in the level of groundwater.

In arid agricultural lands, seepage losses of irrigation canals (rivers, canals, etc.) have a serious impact on the change in the level of seepage waters. To determine the effect of filtration losses from irrigation canals on the change in the groundwater level, we will use mathematical relations (2).

To determine the effect of filtration losses in irrigation canals on the change in the groundwater level, we consider the saturated and aerated parts of the soil together. Combining these zones, we do together solving equations (5) and (2).

$$\frac{\partial}{\partial t}\int_{L_1}^L \theta dz = (\mu_H - \theta_m)\frac{\partial h}{\partial t}$$

$$h = h^* \cos\{\frac{T_1}{T_2} \arccos[\frac{Q}{Q^*} + \frac{\partial Q}{Q^*}\delta(Q - Q^*)]\} \qquad (6)$$

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It has been proven that the system of equations (3 and 4) can be used to describe the change in the level of moisture content of sand and soil depending on the change in the level of underground seepage water caused by a change in flow to irrigation networks.

With the help of the above modeling, the productivity and quality indicators of agricultural crops are expressed when irrigated by irrigation methods, and on the other hand, the correctness of the experimental results is confirmed.

Conclusion

The most important of the results obtained is that it is very difficult to experiment with the amount of surface irrigation of crops in the field. With the help of the obtained models, the possibility of determining the acceptability between them by taking the largest and smallest indicators used in a full-scale experiment was proved.

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